



International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Special Issue 5, December 2014

DSP Processors for Controlling the UPQC System

Ajal.A.J¹, Chikku Jose², Manu Jacob³

Chief Mentor, IMET Solution, Kerala, India¹

Assistant Professor, GEC, Kozhikode, Kerala, India²

M.Tech Student, Federal Institute of Science and Technology, Angamaly, Kerala, India³

ABSTRACT: A short dip in supply voltage, unnoticed by the majority of electricity consumers, can still stop an entire production line in highly sensitive industries such as computer chip manufacturing, oil refining .etc.We have to develop and successfully introduce systems to overcome these obstacles by means of advanced power electronics. In this paper , a novel approach on active series & shunt power line conditioner upqc (unified power quality conditioner) has been described. It is a combination of a STATCOM as well as DVR .a series compensating stage connected before the load in series with the mains using a matching transformer. UPQC can mitigate voltage sag, swell, voltage transient & voltage unbalance. UPQC can supply VAR to the load. DSP based controller is connected to UPQC in order to increase the system performance

Why is Power Quality Important?

In a nut shell we can brief it as [1]

- Cost
- Competitiveness
- Down time
- Losses
- Loss of life
- Metering error
- EMC
- Proper service to the load

I. CUSTOM POWER DEVICES

Concept introduced hingerani. Custom power devices enhance the quality and reliability of power delivered to the customer .Custom power devices are designed to improve the quality of power at their point of installation of power distribution systems. They are not primarily designed to improve power quality of the entire system.With a custom power device ,a customer will be able to receive a prespecified quality of electric power with a combination of specifications including bt not limited to small phase imbalance, Low flicker in supply vtg, Control of power interruptions, Control of supply vtg freq, Low harmonic distortion in supply, load voltage and current.

UPQC_UPQC stands for Unified Power Quality Conditioner. UPQC is an active series & shunt power line conditioner. It is a combination of STATCOM as well as DVR - a series compensating stage connected before the load in series with the mains using a matching transformer. UPQC is the ideal power electronic device to solve the power quality problems. UPQC can mitigate voltage sag, swell, voltage transients and voltage unbalance. UPQC can supply VAR to the load

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Special Issue 5, December 2014

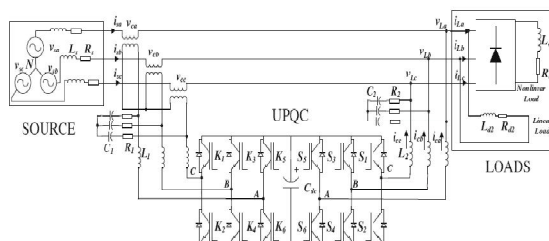


Fig:1 The topology of a three-phase UPQC with different loads. [2]

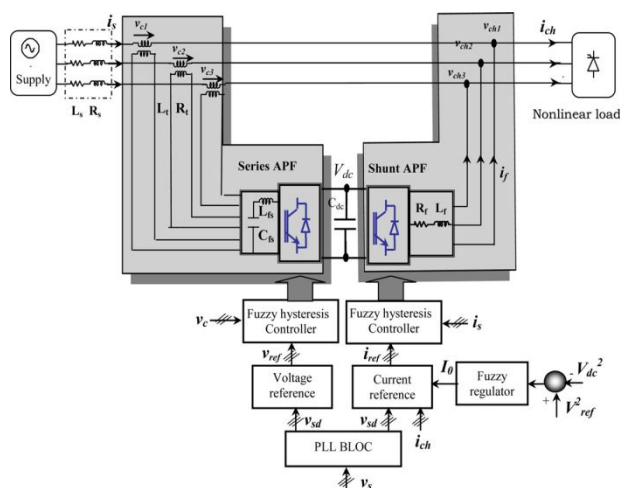


Fig:2 UPQC Demystified

The major components present in UPQC includes Series converter, Shunt converter, Mid point –to–ground DC capacitor bank, Low pass filter, High pass filter, Series and shunt transformers

How STATCOM work in the UPQC?

Shunt Active Series STATCOMS has the capability to generate and absorb variable reactive power by switching the IGBT based voltage source converter (VSC). STATCOM belongs to a synchronous link converter (SLC). The supply voltage and PWM voltage generated by the converter are isolated by a Boost reactor. Using DQ Theory the change in fundamental component of the PWM voltage allow the converter to draw either Leading or lagging supply current from the mains. The converter is capable of generating capacitive or inductive current based on the feedback taken from the load current. The IGBT based voltage source converter (VSC) generates an AC voltage which is in phase with the mains voltage. This voltage determines the direction of the current flowing through the reactor lag/lead. When the voltage generated by the VSC greater than the mains voltage a leading reactive currents is drawn from the mains and the STATCOM acts like a capacitor. In the case when the mains voltage is greater than the voltage developed by the VSC, a lagging current is drawn from the mains and the STATCOM acts like a reactor.

How DVR work the UPQC ?

A DVR (Dynamic Voltage Restorer)-is a solid state electronic Power Conditioner DVR provides a constant output voltage which gives a clean sinusoidal waveform free from spikes, transients, voltage sags, voltage dips, under voltage and over voltage.

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Special Issue 5, December 2014

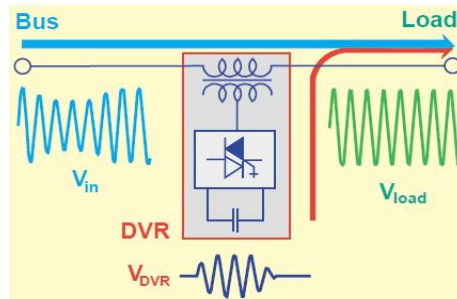


Fig:2 line diagram of DVR

The DVR maintains the applied to the connected load during sags and swells by injecting a compensating voltage of proper magnitude and phase angle through a series transformer. It is capable of injecting up to 35% of line-to-ground voltage on all three phases of the feeder, for up to 20 cycles. It can corrects for up to 20 cycles. It can thus corrects for the vast majority of sags and swells originating on the distribution system including under voltage and over voltage.

Key features: [3]

DVR response time < 1 ms, Power ratings, Available for indoor installation or in weatherproof containers, Efficiency better than 95.5 %.

The inverter in the DVR can boost & buck the line voltage by 20-30% of the mains voltage to provide a constant voltage to the connected load. The DVR is having excellent dynamics with a correction speed of less 1 millisecond which is far superior to a servo stabilizer.

II. BENEFITS OF DVR

Reduces losses from process shut down and product degradation, Protects expensive and sensitive production equipment from voltage anomalies, Minimizes the potentials for production shut downs due to faults elsewhere on the distribution systems including those caused by the lightning strikes.

UPQC is a total of STATCOM and DVR

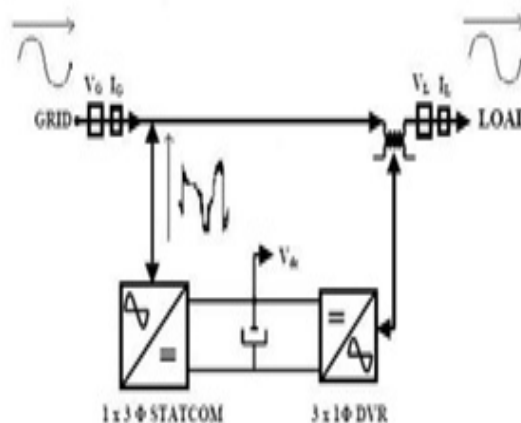


Fig:3 line diagram of UPQC

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Special Issue 5, December 2014

Equivalent circuit of UPQC [4]

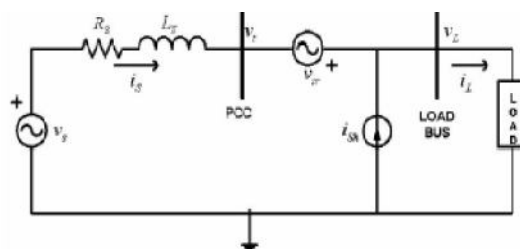
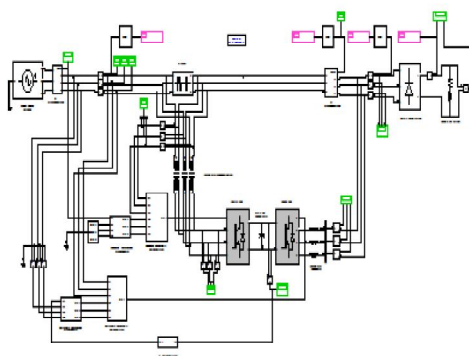


Fig:4 Equivalent circuit of UPQC

Simulink model of UPQC



III. FUNCTION

Load Voltage Regulation by series Voltage Injection. & Dynamic Current injection for reactive power compensation . UPQC issued to compensate voltage and current harmonics, control input power factor to near unity as well as regulate the load voltage. It can be installed by the electric utilities to damp out harmonic propagation caused by resonance with line impedance and passive shunt compensators. Power Factor correction system ensures optimum power for the running loads, thereby: a) Avoidance of Power Factor penalty b) Reduction in Maximum Demand (KVA) c) Reduction in Energy (KWH) Consumption d) Claim higher Power Factor Incentives

IV. DSP BASED CONTROLLERS IN UPQC

TMS 320 C5X nomenclature

- **TMX** : Experimental device
- **TMP** : Prototype
- **TMS** : Qualified device
- **C**: CMOS Tech with on – chip non- volatile memory as ROM
- **E**: CMOS tech with on-chip non – volatile memory as EPROM
- **nothing** : NMOS tech with on-chip non – volatile mem as ROM
- **5** : Generation
- **X** : Version number- 0,1,2,3,4x,5,6,7

F28x denotes all the Flash devices

We have gone for an industrial training at Hykon industries pvt ltd in kerala . Below shown is the snap shot of UPQC manufactured there.

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Special Issue 5, December 2014

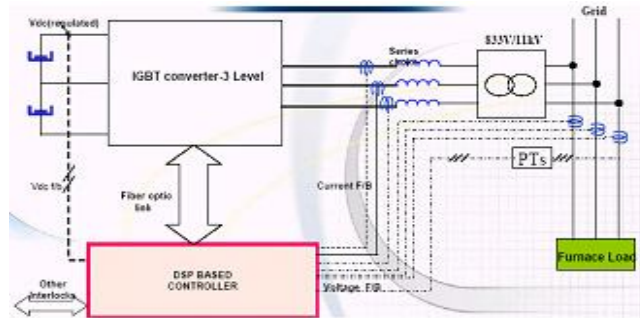


Fig:5 block diagram of DSP based controller connected to UPQC

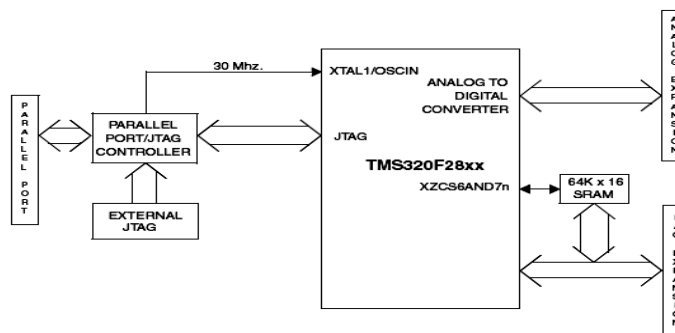


Fig:6 Block diagram of DSP based control board



UPOC - 250 KVA

fig: 7 A 250 KVA UPQC product from Hykon india (p) ltd.

V. FUTURE SCOPE

The economics for the capacity enhancement of UPQC should also be analyzed. the flexibility of UPQC to increase its capacity in future and to cope up with the increase load demand in low voltage distribution level has not been achieved. simulations to be carried out by the PSCAD®/ EMTDC™ - ElectroMagnetic Transients including DC



ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Special Issue 5, December 2014

VI. CONCLUSION

The effects of power quality problems on the loads and other components depend on the type of components and the type of quality problems. The sensitivity of loads to power quality is variable even with a specific category of loads. This paper mention UPQC and simulation model using simulink has been carried out. Detail on **TMS 320 C5X** DSP processors has been carried out successfully.

REFERENCES

- [1] A PSERC Tutorial on Contemporary Topics in Electric Power Quality , G. T. Heydt , Arizona State University
- [2] Y. Rong et al. / Simulation Modelling Practice and Theory 17 (2009) 955–966 Paper title: An adaptive harmonic detection and a novel current control strategy for unified power quality conditioner
- [3] Analysis of unified power quality conditioner during voltage sag and swell conditions , B. JYOTHI et al. [IJESAT] Volume -2, Issue - 1, 85 – 91
- [4] Khadkikar V, Agarwal P, Chandra A, Barry A O and Nguyen T.D, “A simple new control technique for unified power quality conditioner (UPQC)”,Harmonics and Quality of Power, 2004. 11th International Conference on 12-15 Sept.2004, pp. 289 – 293.

BIOGRAPHY



AJAL.A.J Currently working as **CHIEF MENTOR – IMET SOLUTION – KERALA**. **AJAL.A.J** completed his ME VLSI DESIGN In Bannariamman institute of technology, sathyamangalam, erode district under Anna university Tamil nadu India. He has published 12 papers in International conference, and 24 papers in national conference. His area of interests includes mobile WiMAX, wide band radiators, and interference analysis.



CHIKKU JOSE Assistant professor at GEC – KOZHIKODE. She had completed m tech Communication and signal processing from GEC – WAYANAD . Her recent Publication includes “**Enhancement of Color Images in the DCT Domain**” *National Conference on Information Technology, Communication and Signal Processing (CISP)*, March-2013.Done her Industrial training at Regional Telecom Training Centre (RTTC), Mysore. She also attended Workshop on Analog Signal Processing at Cranes Varsity, Bangalore



MANU JACOB Currently PG Scholar , completed his B Tech from SNMIMT Maliankara.